

## CLAIMS

What is claimed is:

1. A liquid filter comprising a housing having an inlet and an outlet, a filter element in said housing and having an upstream outer face communicating with said inlet, and a downstream inner face communicating with said outlet, said filter element filtering liquid passing therethrough from said outer face to said inner face, said housing having a sidewall which defines with said outer face an inlet chamber therebetween having an upper section and a lower section, such that as liquid enters said inlet chamber from said inlet, gas in said liquid rises to said upper section of said inlet chamber, a low level of liquid indicating a low pressure drop non-plugged condition of said filter element, the higher the level of said liquid in said inlet chamber the greater the pressure drop across said filter element and the greater the plugging of said filter element, a change interval plugging indicator in said housing comprising a gas trap and pressure responsive release mechanism trapping said gas in said upper section of said inlet chamber until a designated release pressure is reached, corresponding to a desired terminal pressure, to prevent premature plugging indication otherwise indicated by rising liquid level in said inlet chamber.

2. The liquid filter according to claim 1 wherein said change interval plugging indicator comprises an outer wrap around said outer face of said filter element in said upper section of said inlet chamber and blocking gas flow therethrough at least at pressures below said designated release pressure.

3. The liquid filter according to claim 2 wherein said outer wrap has a lower end which defines a lower end of said upper section of said inlet chamber and an upper end of said lower section of said inlet chamber, and wherein said gas is trapped in said upper section of said inlet chamber when liquid in said inlet chamber rises above said lower end of said outer wrap.

4. The liquid filter according to claim 3 wherein said filter element is an axially extending annulus having an outer surface providing said outer face, and having an inner surface providing said inner face and defining a hollow interior, said filter element having a lower axial end having an opening at said hollow interior and communicating with said outlet, said filter element having an upper axial end, and comprising a check valve at said upper axial end of said filter element, said check valve having a first side communicating with said hollow interior and having a second side communicating with said upper section of said inlet chamber, said check valve having a closed condition below said designated release pressure, and an open condition above said designated release pressure.

5. The liquid filter according to claim 4 wherein said check valve comprises porous media at said upper axial end covering said hollow interior and blocking gas flow therethrough below said designated release pressure, and passing gas flow therethrough above said designated release pressure.

6. The liquid filter according to claim 4 wherein said check valve comprises a biased valve member having a normally closed condition below said designated release pressure, and having an open condition overcoming said bias above said designated release pressure.

7. The liquid filter according to claim 4 wherein said outer wrap is nonporous.

8. The liquid filter according to claim 7 wherein said outer wrap has a permeability substantially lower than said filter element.

9. The liquid filter according to claim 3 wherein said outer wrap is a porous member wetted by said liquid such that capillary pressure in said porous

member blocks gas flow therethrough below said designated release pressure, and such that pressure above said designated release pressure overcomes said capillary  
5 pressure and gas passes through said outer wrap.

10. The liquid filter according to claim 1 wherein said gas trap and pressure responsive release mechanism delays rise in liquid level in said inlet chamber for applications where said filter element is changed prematurely and has a longer life than otherwise indicated by said rising liquid level in said inlet chamber.

11. The liquid filter according to claim 1 wherein said inlet chamber is viewable through said housing such that an operator can see the level of liquid in said inlet chamber.

12. In a liquid filter comprising a housing having an inlet and an outlet, a filter element in said housing and having an upstream outer face communicating with said inlet, and a downstream inner face communicating with said outlet, said filter element comprising filter media performing a filtration function  
5 by passing liquid therethrough, said housing having a sidewall which defines with said outer face an inlet chamber therebetween having an upper section and a lower section, such that as liquid enters said inlet chamber from said inlet, gas in said liquid rises to said upper section of said inlet chamber, such that during use, liquid level in said inlet chamber rises and said gas disappears as permitted by gas flow through said  
10 filter media, the rising of said liquid level and the disappearing of said gas being used in the prior art for indicating a change interval for the filter element, whereby said filter media provides both a filtration function and a plugging indication function in the prior art,

an improved interval change plugging indication method comprising  
15 separating said filtration function and said plugging indication function by trapping gas in said inlet chamber and releasing said gas in response to a designated release

pressure corresponding to a desired terminal pressure.

13. The method according to claim 12 wherein during use, the pressure drop across said filter media increases as the latter becomes more restrictive to liquid flow therethrough as more contaminant is captured, and wherein said designated release pressure is independent of and does not vary with the increasing  
5 restriction of said filter media to liquid flow therethrough.

14. The method according to claim 12 comprising performing said filtration function with a first member provided by said filter media, and performing said plugging indication function with a second member different than said first member.

15. The method according to claim 14 wherein the flow properties of said first member vary during filtration, and the flow properties of said second member do not substantially vary during filtration.

16. The method according to claim 14 comprising providing said second member by an outer wrap around said outer face around said filter element, said outer wrap having a lower permeability than said filter media, and calibrating said designated release pressure corresponding to said desired terminal pressure  
5 according to bubble point of said outer wrap.

17. The method according to claim 12 wherein said inlet chamber is viewable through said housing, and said method is a gas visualization interval change plugging indication method.

18. A filter element for a liquid filter having a housing having an inlet and an outlet and housing said filter element therein, said filter element having

an upstream outer face communicating with said inlet, and a downstream inner face communicating with said outlet, said housing having a sidewall defining an inlet chamber between said sidewall and said upstream outer face, wherein liquid is filtered by flowing from said inlet chamber through said filter element from said upstream outer face to said downstream inner face, said liquid giving off vapor gas within said housing, the higher the level of said liquid in said inlet chamber the greater the pressure drop across said filter element and the greater the plugging of said filter element, said filter element including a delay member for delaying the rise in liquid level in said inlet chamber for applications where said filter element is changed prematurely and has a longer life than otherwise indicated by said rising liquid level in said inlet chamber.

19. The filter element according to claim 18 wherein said delay member comprises a change interval plugging indicator comprising a gas trap and pressure responsive release mechanism trapping said gas to delay the rise in liquid level in said inlet chamber for applications where said filter element is changed prematurely and has a longer life than otherwise indicated by said rising liquid level, and releasing said gas in response to a designated release pressure corresponding to a desired terminal pressure, to prevent premature plugging indication otherwise indicated by said rising liquid level.

20. The filter element according to claim 19 wherein said gas trap and pressure responsive release mechanism traps said gas in said inlet chamber until said designated release pressure corresponding to said desired terminal pressure, and then releases said gas to escape to said outlet, which escaping gas is replaced by increasing liquid levels in said inlet chamber, indicating that said designated release pressure corresponding to said desired terminal pressure has been reached, in turn indicating that replacement of said filter element is due.

21. The filter element according to claim 19 wherein said filter element comprises filter media performing a filtration function filtering said liquid, and wherein during use, the pressure drop across said filter media increases as the latter becomes more restrictive to liquid flow therethrough as more contaminant is captured, and wherein said designated release pressure is independent of and does not vary with said increasing restriction of said filter media to liquid flow therethrough.

22. The filter element according to claim 19 wherein said filter element comprises a first member provided by filter media performing a filtration function filtering said liquid, and a second member provided by said gas trap and pressure responsive release mechanism performing a plugging indication function, said second member being different than said first member and separating said plugging indication function from said filtration function.

23. The filter element according to claim 22 wherein the flow properties of said first member vary during filtration, and the flow properties of said second member do not substantially vary during filtration.

24. The filter element according to claim 22 wherein said second member comprises an outer wrap around said outer face and having a lower permeability than said filter media, and wherein said designated release pressure corresponding to said desired terminal pressure is calibrated according to bubble point of said outer wrap.

25. The filter element according to claim 19 wherein said change interval plugging indicator comprises an outer wrap around said outer face of said filter element in said upper section of said inlet chamber and blocking gas flow therethrough at least at pressures below said designated release pressure.

26. The filter element according to claim 25 wherein said outer wrap has a lower end which defines a lower end of said upper section of said inlet chamber and an upper end of said lower section of said inlet chamber, and wherein said gas is trapped in said upper section of said inlet chamber when liquid in said inlet  
5 chamber rises above said lower end of said outer wrap.

27. The filter element according to claim 26 wherein said outer wrap is a porous member wetted by said liquid such that capillary pressure in said porous member blocks gas flow therethrough below said designated release pressure, and such that pressure above said designated release pressure overcomes said  
5 capillary pressure and gas passes through said outer wrap.

28. The filter element according to claim 26 wherein said filter element is an axially extending annulus having an outer surface providing said outer face, and having an inner surface providing said inner face and defining a hollow interior, said filter element having a lower axial end having an opening at said hollow  
5 interior and communicating with said outlet, said filter element having an upper axial end, and comprising a check valve at said upper axial end of said filter element, said check valve having a first side communicating with said hollow interior and having a second side communicating with said upper section of said inlet chamber, said check valve having a closed condition below said designated release pressure, and an open  
10 condition above said designated release pressure.

29. The filter element according to claim 28 wherein said check valve comprises porous media at said upper axial end covering said hollow interior and blocking gas flow therethrough below said designated release pressure, and passing gas flow therethrough above said designated release pressure.

30. The filter element according claim 28 wherein said check valve comprises a biased valve member having a normally closed condition below said designated release pressure, and having an open condition overcoming said bias above said designated release pressure.

31. The filter element according to claim 28 wherein said outer wrap is substantially nonporous.

32. The filter element according to claim 31 wherein said outer wrap has a permeability substantially lower than said filter element.

33. The filter element according to claim 18 wherein said inlet chamber is viewable through said housing such that an operator can see the level of liquid in said inlet chamber as an indication of when to replace said filter element.